

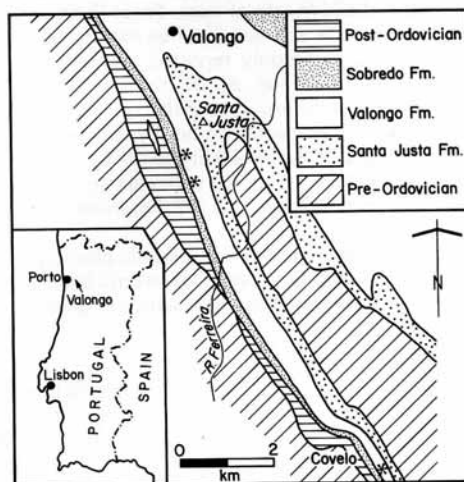
THE TRILOBITE *ECCOPTOCHILE* FROM THE ORDOVICIAN OF NORTHERN PORTUGAL

by M. ROMANO

ABSTRACT. The eccoptochilinid trilobite fauna from the Ordovician of the Valongo area, north Portugal, is revised. The holotype of *Eccoptochile* (?*Eccoptochile*) *mariana* (Verneuil and Barrande, 1855) is redescribed and figured and the species is restricted to the type specimen and two specimens from Valongo. Specimens previously described as *E. (?E.) mariana* from Spain, north Portugal, and southern England, together with other and new material from Portugal are here included within the new species *E. (Eccoptochile) almadenensis*. *E. (Eccoptochile) cf. clavigera* (Beyrich, 1845) is recorded from the Valongo area.

THIS revision of the genus *Eccoptochile* from the Ordovician of north Portugal forms part of a larger project concerned with systematic description and distribution studies of the Ordovician trilobite faunas of that region. The faunas from the Valongo area about 10 km east of Porto (text-fig. 1) have been well known since Delgado published extensive faunal lists from the beds (1908, pp. 106–109); only '*Uralichas Ribeiroi*' (Delgado, 1892, 1897) was described. Delgado listed '*Cheirurus claviger* Beyrich', '*Cheirurus Guillieri* Tromelin (aff. *C. claviger* Beyrich)', and '*Cheirurus* sp. n. (aff. *C. Sedgwicki* McCoy)' from his uppermost division, the '*Schistes à Uralichas Ribeiroi*', of the '*Ordovician moyen*' from the Valongo area. Prior to this Sharpe (1849) had recorded '*Chirurus*' from the Porto region but this specimen was later recognized by Salter (1853) as '*Placoparia Zappei*, Boeck'. The most recent systematic work on this group was by Curtis (1961) who apparently regarded all three of the species listed by Delgado as conspecific and referred them to *Eccoptochile mariana* (Verneuil and Barrande).

The '*Schistes à Uralichas Ribeiroi*' have generally been regarded as Llandeilo in age (Costa 1931;



TEXT-FIG. 1. Simplified geological map of the area south of Valongo (after Delgado 1908), showing localities (asterisks) where the species of *Eccoptochile* described in the text have been recorded.

Teixeira 1955; Thadeu 1956) and more recent work on certain elements of the fauna, notably harpids (Romano 1975), placopariids (Romano 1976), and dionidids (Henry and Romano 1978), suggests a possible Lower Llandeilo age, equivalent to the *Placoparia (Coplacoparia) tournemini* biozone of Spain and Brittany (Hammann 1971a; Henry and Clarkson 1975). The 'Schistes à *Uralichas Ribeiroi*' are included within the upper part of the Valongo Formation (Romano and Diggens 1973–1974) which is a thick sequence of argillaceous sediments ranging in age from Upper Llanvirn (*Didymograptus purchisoni* Zone) to ?Upper Llandeilo. The formation crops out about 10 km east of Porto and it is from this area that the bulk of the collections were made by Delgado, Wattison, and the present author with J. N. Diggens. The problem of accurately locating the material collected by Wattison was outlined earlier (Romano 1976) and similar difficulties arise with some of the specimens from the Delgado collection.

The collections used in this paper are housed in the British Museum (Natural History), London (Wattison Collection—(BM In)); École Nationale Supérieure des Mines, Paris (T); Serviços Geológicos, Lisbon (Delgado Collection—SG); Institute of Geological Sciences (GSM), and in the Geology Department, University of Sheffield (SU).

SYSTEMATIC PALAEOLOGY

General remarks. *E. (Eccoptochile) clavigera* (Beyrich, 1845), *E. (?Eccoptochile) mariana* (Verneuil and Barrande, 1855) and *E. (?Eccoptochile) guillieri* (Tromelin in Guillier, 1873) form a relatively homogeneous group within which the north Portuguese specimens clearly belong. The first two are generally regarded as valid species but *E. (?E.) guillieri* has fairly recently been placed into synonymy with *E. (?E.) mariana* by Hammann (1974, p. 105). *E. (?E.) guillieri* was compared with *E. (E.) clavigera* by Tromelin and Lebesconte (1876, p. 637) who noted that the glabella of the former differed from that in *E. (E.) clavigera* in being smooth, more convex, with the posterior end of the axial furrows curved inwards more strongly. The outline diagrams and locality information of the specimens of *E. (?E.) guillieri* shown in text-fig. 2 (g, h, i) were kindly sent to me by Dr. J.-L. Henry; they are of the holotype (2g) and a topotype (2h, i from the Kerforne collection). The latter is an incomplete but undeformed specimen, preserved in a nodule, from the type locality 'la Butte du Creux', near Saint-Denis-d'Orques (Sarthe); Dr. Henry informed me that it is Llanvirn or Llandeilo in age. This topotype shows a very narrow (sag.) frontal area and a strongly and evenly curved glabella in lateral view. From these two specimens *E. (?E.) guillieri* warrants retention as a separate species and is treated as such in this paper.

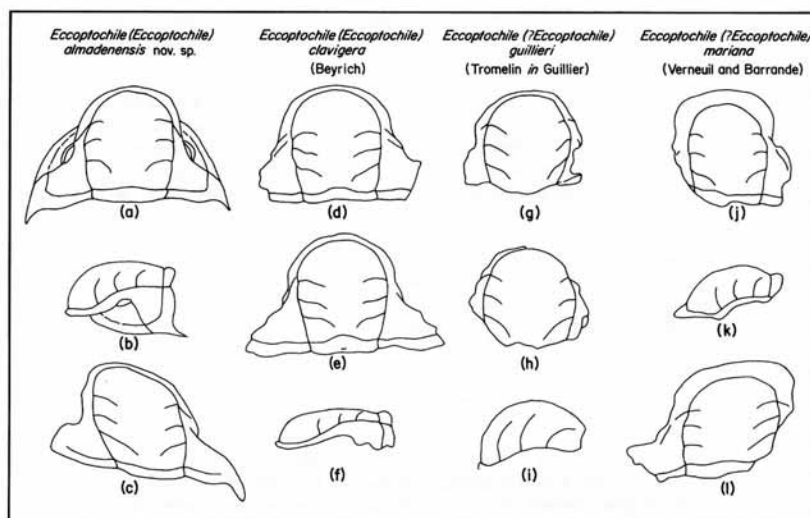
The most commonly reported species of *Eccoptochile* in Iberia and the Armorican Massif is *E. mariana* (Curtis, op. cit.; Hammann 1971, 1974; Lindström, Racheboeuf and Henry 1974), but a recent study of the holotype of this species by the author suggests that the species has been interpreted too widely in the past. The holotype of *mariana* is redescribed and figured here.

Prantl and Přibyl (1948) erected the subgenus *Eccoptochile (Eccoptochiloides)* on the basis of the thorax containing only ten segments and the four pairs of pleural spines on the pygidium. As the thorax and pygidium of *E. (?E.) mariana* are unknown the subgeneric status of *mariana* is still in doubt.

The morphological terms used are essentially those listed by Harrington *et al.* (in Moore, 1959). Lateral glabellar lobes and furrows are labelled 'L' and 'S' respectively and are numbered from the posterior forwards. The classification employed is that of Henningsmoen (in Moore, 1959) and Lane (1971).

Family CHEIRURIDAE Hawle and Corda, 1847
Subfamily ECCOPTOCHILINAE Lane, 1971
Genus ECCOPTOCHILE Hawle and Corda, 1847

Type species. *Cheirus claviger* Beyrich, 1845



TEXT-FIG. 2. Outline sketches of the cephalon or cranidia of the holotype and other material of selected species of *Eccoptochile*: a-c, *Eccoptochile (Eccoptochile) almadensis* sp. nov. a, b, Holotype (selected), from Hammann, 1974, pl. 12, fig. 192c and 192b (reversed for comparison); c, from Curtis, 1961, pl. 2, fig. 1. d-f, *Eccoptochile (Eccoptochile) clavigera* (Beyrich); d, Holotype, from Beyrich, 1845, pl. (unnumbered), fig. 2; e, f, from Barrande, 1852, pl. 40, figs. 1, 2. g-i, *Eccoptochile (?Eccoptochile) guillieri* Tromelin in Guillier); g, Holotype, h, i, Topotype. Both drawings taken from photographs and drawings supplied by Dr. J.-L. Henry. j-l, *Eccoptochile (?Eccoptochile) mariana* (Verneuil and Barrande); j, k, Holotype, from Verneuil and Barrande, 1855, pl. 23, fig. 4 and present paper, pl. 1, figs. 1-4; l, Paratype, from Curtis, 1961, pl. 1, fig. 1 and refigured here, pl. 1, figs. 5, 6. Sketches drawn to approximately the same size.

Eccoptochile (?Eccoptochile) mariana (Verneuil and Barrande, 1855)

Plate 78, figs. 1-7; text-fig. 2 j-l

- *1855 *Cheirus marianus* Verneuil and Barrande, p. 970, pl. 23, fig. 4 (not p. 972, pl. 28 as stated by Hammann, 1974, p. 105).
- 1961 *Eccoptochile mariana* (Verneuil and Barrande); Curtis, p. 6, pl. 1, fig. 1 (not pl. 1, fig. 2, pl. 2; figs. 1, 2, ?pl. 3, fig. 1).
- 1974 *Eccoptochile* cf. *mariana* (Verneuil and Barrande); Hammann, p. 105 (referring to Curtis, 1961, pl. 1, fig. 1).

Diagnosis. (Modified from Verneuil and Barrande, 1855, p. 970.) A species of *Eccoptochile* with the following characteristics: strongly arched glabella with evenly curved longitudinal profile and, with occipital ring vertical, highest part level with the anterior part of L2. Wide frontal area over 12% of the glabellar length (excluding occipital ring) and consists of a more or less flat preglabellar field and a gently rounded anterior border. Palpebral lobe level with the posterior part of L2 to the posterior part of L3. Eye ridges are faintly visible running from the anterior of the palpebral lobe towards S3. Hypostoma, thorax, and pygidium unknown.

Type and figured material. Holotype: T 150 (Plate 78, figs. 1-4). Internal mould of incomplete cranidium (Verneuil and Barrande, 1855, pl. 23, fig. 4). Other figured material. BM In49177 (Plate 78, figs. 5, 6) (Curtis, 1961, pl. 1, fig. 1); BM In49182 (Plate 78, fig. 7).

Horizon and locality. Holotype from 'Puente de las Ovejas' near Ciudad Real, Spain; Upper Llandeilo (Hamman, 1974, p. 105). BM In49177 and In49182 from Covelo, near Valongo, north Portugal; upper part of Valongo Formation, probably Lower Llandeilo.

Description of holotype. Measurements with occipital ring vertical: length (sag.) of glabella (excluding occipital ring) and frontal area, 15.75 mm; length of glabella, 14.00 mm. Glabella longer than wide with even, outwardly curved lateral margins, slightly indented at S3, and a broadly rounded anterior margin; widest part of the glabella just anterior to the S2 furrows. L1 lobes subtriangular in outline, about one-quarter glabellar length and delimited by deep, well-marked S1 furrows which have an S-shaped trace and die out just under one-third glabellar width from axial furrows. L2 lobes rectangular in outline, shorter (trans.) than L1 and about the same length (exsag.). S2 furrows shorter and less well-marked than S1, evenly curved, parallel to the abaxial part of S1, starting just posterior to the midlength of the glabella. L3 similar in shape and orientation to L2, but appear to be very slightly longer. S3 furrows parallel to S2 but do not reach as far towards the midline. S3 start at nearly two-thirds the glabellar length from the posterior margin.

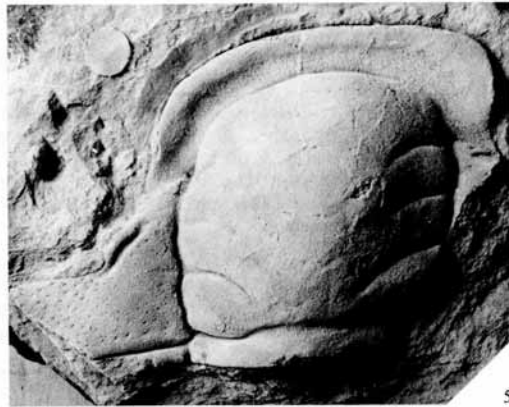
Glabella strongly arched transversely with a subtriangular cross section. Longitudinally (occipital ring vertical) the glabella is evenly curved dorsally, highest part lying above the anterior part of L2. Median glabellar lobe, L2 and L3 without independent convexity but L1 lobes are slightly bulbous. Frontal area wide (sag., exsag.), of more or less constant width around the frontal glabellar lobe but increasing at anterolateral corners where anterior margin of fixed cheek turns back rather sharply to give a more angular, although still rounded outline. Frontal area consists of an inner preglabellar field which is more or less flat or very slightly upwardly concave which grades into the frontal lobe of the glabella without a marked furrow. Preglabellar field also grades into anterior border which is gently rounded and lies horizontally. Anterolaterally the border is slightly wider. At anterolateral corners border appears to be directed more upwards but this may be an effect of deformation. Axial furrows well-marked from the occipital furrow to S3 where there is a deep pit just abaxial to axial furrow. Anterior to this pit axial furrow rapidly dies out. Occipital furrow curved forwards behind the median glabellar lobe and where it runs into the axial furrows, deep posterior to the L1 lobes and wide and shallow in the median part. Occipital ring not complete: posterior to the L1 lobes ring curves forwards. Incomplete free cheeks are narrow (trans.) opposite the palpebral lobes and fairly flat. Posterior border furrow deep, starting from the axial furrow just posterior to the occipital furrow. Posterior border narrow (exsag.) and convex. Convex (tr.) palpebral lobe slightly curved, lying oblique to sagittal line and separated from fixed cheek by a well-marked palpebral furrow which dies out anteriorly along length of lobe. Faint eye ridge extends from palpebral lobe to axial furrow at S3. Palpebral lobe level with posterior part of L2 to the posterior part of L3. Faint granular ornament on glabella but the distribution is not clear. On the fixed cheeks there is an irregular distribution of pits.

The figured material from Valongo assigned to this species is virtually identical to the holotype, differing mainly in convexity. The Portuguese specimens are flattened dorso-ventrally and slightly distorted obliquely. The transverse and longitudinal profiles of the cranidia do not show the high convex glabella of the holotype but the relative proportions of the cranidia are the same. This species is discussed further below.

EXPLANATION OF PLATE 78

Figs. 1-7. *Eccoptochile* (?*Eccoptochile*) *mariana* (Verneuil and Barrande). 1-4, holotype, internal mould; T 150. 'Puente de las Ovejas' near Ciudad Real, Spain; Upper Llandeilo. 1-3, dorsal, frontal, lateral views respectively, $\times 3$. 4, detail of cheek ornament, $\times 9$. 5, 6, internal mould; In49177. Covelo, north Portugal. Upper part of Valongo Formation; Lower Llandeilo. 5, dorsal view. 6, frontal view. Approximately $\times 2$. 7, internal mould; In49182. Covelo, north Portugal. Upper part of Valongo Formation; Lower Llandeilo. Dorsal view, $\times 1$.

Figs. 8, 9. *Eccoptochile* (*Eccoptochile*) *almadenensis* sp. nov. Internal moulds. 8, GSM CR 1526. Gorran Quartzites, Perhaver Beach, Cornwall; Llandeilo. Dorsal view, $\times 2$. 9, SG 3A2. 1400 m S 32° E of Covelo church, north Portugal. Upper part of Valongo Formation; Lower Llandeilo. Dorsal view, $\times 1$.



ROMANO, Ordovician trilobite *Eccoptochile*

Eccoptochile (Eccoptochile) almadenensis sp. nov.

Plate 78, figs. 8, 9; Plate 79, figs. 1-7; text-fig. 2 a-c

- 1896 *Cheirurus (Eccoptocheile) marianus* (De Verneuil); Reed, p. 164.
 1907 *Cheirurus sedgwicki* M'Coy; Lake in Reid, p. 39.
 1908 *Cheirurus claviger* Beyrich; Delgado, ? p. 57 (refigured by Thadeu, 1947, pl. 3, fig. 2), ? p. 80, p. 106.
 1908 *Cheirurus guillieri* Trom. (aff. *C. claviger* Beyr.); Delgado, p. 106.
 1908 *Cheirurus* sp. n. (aff. *C. sedgwicki* McCoy); Delgado, p. 106.
 1916 *Eccoptochile mariana* (Verneuil and Barrande); Barton, p. 106.
 *1918 *Cheirurus claviger* var. *marianus* Verneuil and Barrande *emend.* Born; Born, p. 351, pl. 27, fig. 1.
 1947 *Cheirurus claviger* Beyrich; Thadeu, p. 228, pl. 3, fig. 3.
 1958 *Eccoptochile clavigera* (Beyrich); Whittard, p. 115 (specimen from Perhaven Beach, Cornwall).
 1961 *Eccoptochile mariana* (Verneuil and Barrande); Curtis, p. 6, pl. 1, fig. 2 (*non* fig. 1), pl. 2, figs. 1, 2, pl. 3, ? fig. 1.
 1969 *Eccoptochile (Eccoptochile)* sp. indet; Racheboeuf, p. 74, pl. 2, figs. 3a, b.
 1971b *Eccoptochile marianus* (Verneuil and Barrande); Hammann, pp. 267, 270.
 1974 *Eccoptochile clavigera* (Beyrich)?; Sadler, p. 73.
 1974 *Eccoptochile (Eccoptochile) mariana* (Verneuil and Barrande); Lindström, Racheboeuf, and Henry, ? pp. 20, 21.
 1974 *Eccoptochile mariana* (Verneuil and Barrande); Hammann, p. 105, text-fig. 39, pl. 11, figs. 188-191, pl. 12, figs. 192-198.
 1978 *Eccoptochile mariana* (Verneuil and Barrande); Henry and Romano, p. 335.

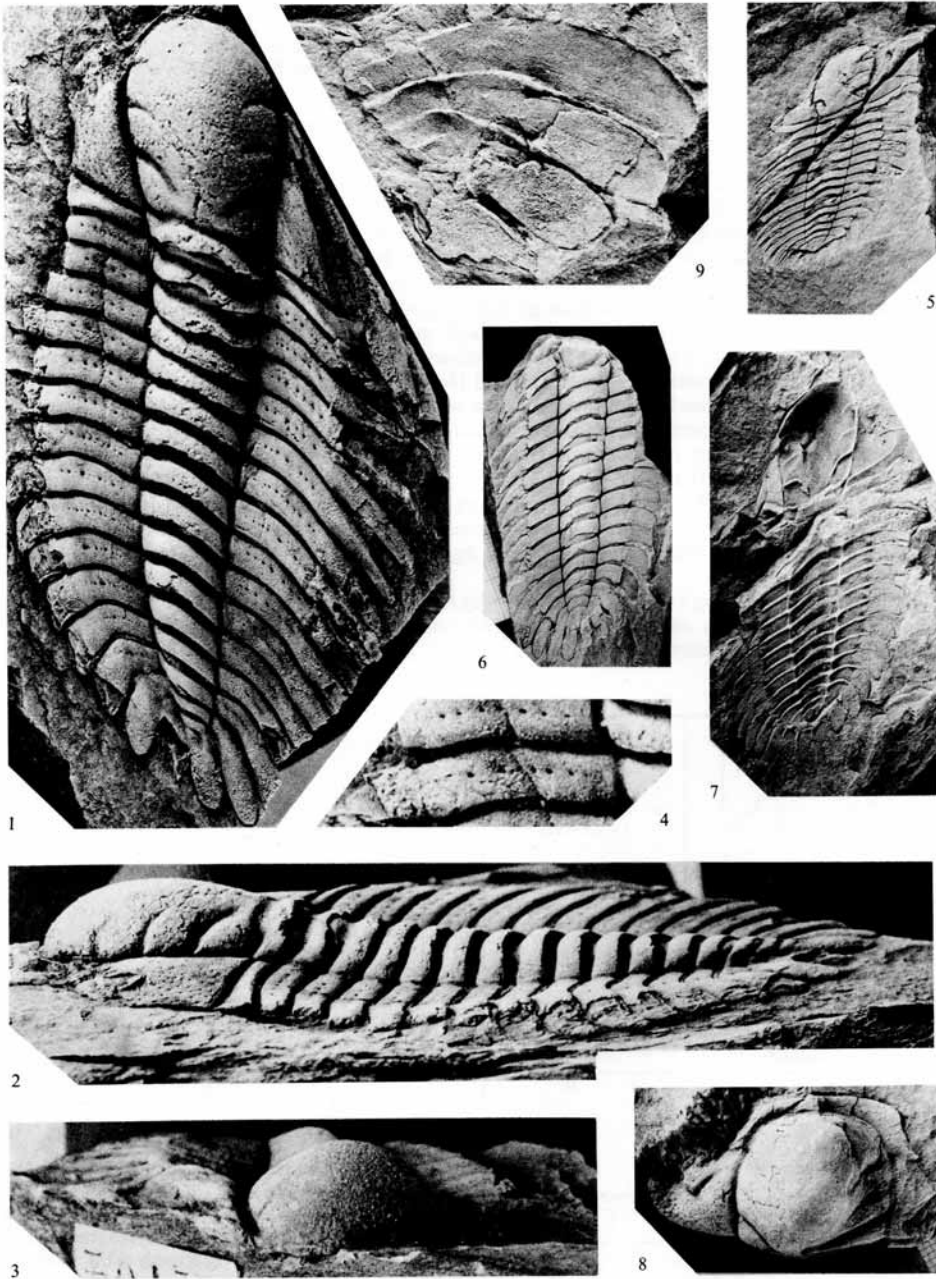
Diagnosis. (Modified from Hammann, 1974, p. 106.) Species of *Eccoptochile* with glabella strongly convex, anterior lobe descending almost vertically to preglabellar field. Frontal area relatively narrow (sag.); anterior border steeply upturned forming an angle with lateral borders of free cheeks (viewed dorsally). Eyes start approximately level with S2 and reach back to S1. Fixed cheeks narrow (sag.). Anterior thoracic segments pointed, becoming gradually more rounded posteriorly. Internal surface of exoskeleton smooth except for pits on cheeks.

Type and figured material. Holotype: (SMG X 337a) Internal mould of cephalon with seven thoracic segments (figured Born, 1918, p. 351, pl. 27, fig. 1; Hammann, 1974, p. 105, pl. 12, figs. 192 a-c). Paratypes: (BM In49178-80) Curtis, 1961, p. 6, pl. 1, fig. 2, pl. 2, figs. 1 and 2 respectively; (SMF 24779-82, 24783₁₋₃, 24784, 24785a, 24787) Hammann, 1974, p. 105, pl. 11, figs. 188, 189, 190-191, pl. 12, figs. 193-198. Other material: GSM GR 1526; SG 1704, SG 1711, and three unnumbered specimens in drawer labelled 3A2 in SG (figured here Pl. 78, fig. 9, Pl. 79, figs. 6, 7).

Horizons and locality. Holotype from Valdemosillo, approximately 16 km ENE of Almaden, Spain; Upper Llandeilo. Paratypes. BM In49178-80 from Covelo, near Valongo, north Portugal; upper part of Valongo Formation, probably Lower Llandeilo. SMF 24779, 24785a from Corral de Calatrava (near Ciudad Real, Spain); Co IIIf, Upper Llandeilo: SMF 24780-82, 24783₁₋₃ from Corral de Calatrava; Co IIIe, Upper

EXPLANATION OF PLATE 79

- Figs. 1-7. *Eccoptochile (Eccoptochile) almadenensis* sp. nov. 1-6, internal moulds, 7, external impression. Upper part of Valongo Formation; Lower Llandeilo. 1-4, SG 1704. 1650 m S 20° W of the summit of Santa Justa, Valongo, north Portugal. 5, SG 1711, 6, 7 (both in drawer labelled 3A2), 1400 m S 32° E of Covelo church, north Portugal. 1-3, dorsal, lateral, frontal views respectively, $\times 2$; 4, detail of thoracic segment, $\times 4$. 5-7, dorsal views, $\times 1$, $\times 0.75$, $\times 1$ respectively.
 Fig. 8. *Eccoptochile (?Eccoptochile) cf. mariana* (Verneuil and Barrande). Internal mould; (no number, same box as SG 1704). 1650 m S 20° W of the summit of Santa Justa, Valongo, north Portugal. Upper part of Valongo Formation; Lower Llandeilo. Dorsal view, $\times 1$.
 Fig. 9. *Eccoptochile (Eccoptochile) cf. clavigera* (Beyrich). External impression. SG (no number, in drawer labelled 3A2). 1400 m S 32° E of Covelo church, north Portugal. Upper part of Valongo Formation; Lower Llandeilo. Dorsal view, $\times 1.5$.



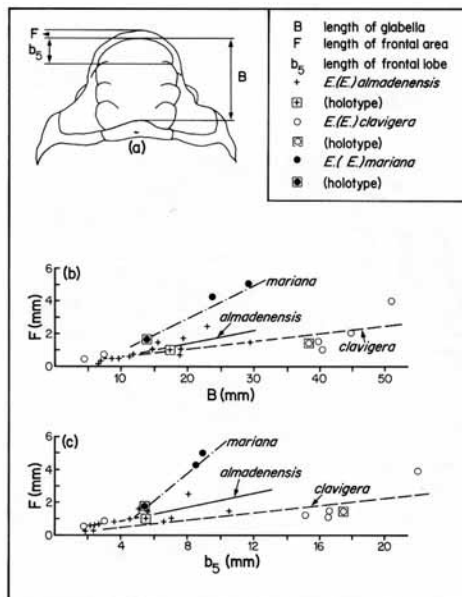
ROMANO, Ordovician trilobite *Eccoptochile*

Llandeilo: SMF 24784 from Navatrasierra (Montes de Toledo, Spain); Na Ia, Lower Llandeilo: SMF 24784 from Navatrasierra (Montes de Toledo, Spain); Na Ia, Lower Llandeilo: SMF 24787 from Navatrasierra (Montes de Toledo); Na Ia, basal Llandeilo.

Description. The types from Spain and Portugal have been well described and figured by Hammann (1974) and Curtis (1961). No further comments are necessary.

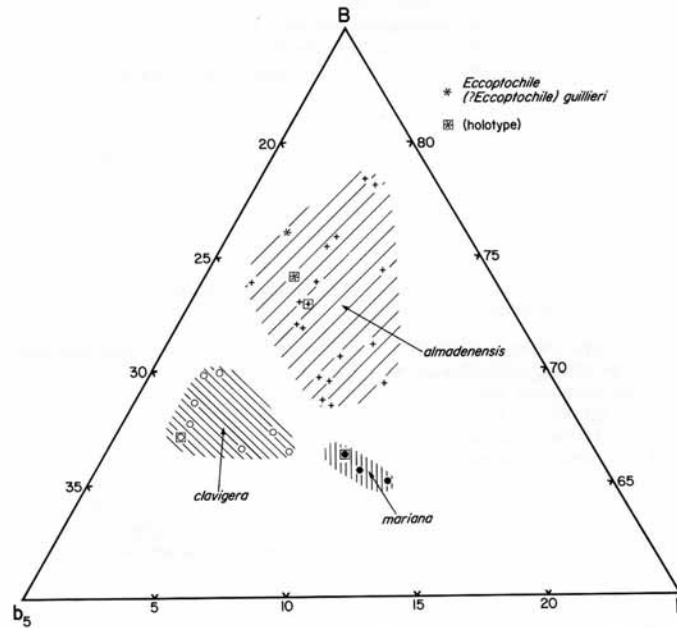
Discussion. Verneuil and Barrande erected *Eccoptochile* (?*Eccoptochile*) *mariana* (1855, p. 970, pl. 23, fig. 4) on the basis of it having a more dorsally convex glabella and a wider, flat anterior border than *Eccoptochile* (*Eccoptochile*) *clavigera* (Beyrich, 1845). They stated that the eye occupied the same relative position in both species. Curtis (1961, p. 8) listed four differences between the two species, including that in *E. (?E.) mariana* (*sensu* Curtis and Hammann) the frontal lobe is relatively shorter, the eye ridge starts level with the anterior glabella furrow and the eye is situated farther back. The specimen figured by Curtis (1961, pl. 1, fig. 1) as *E. mariana*, and later referred to *E. cf. mariana* by Hammann (1974, p. 105) possesses a wide frontal area which distinguishes it from other specimens of *E. (?E.) mariana* as understood by Curtis and Hammann. A reinvestigation of the holotype of *E. (?E.) mariana* also revealed the presence of a wide frontal area and it is thus clearly distinct from the majority of specimens previously assigned to that species. The evenly curved longitudinal profile of the glabella of the holotype (text-fig. 2k and Pl. 78, fig. 3) is also unlike that in *E. (?E.) mariana sensu* Hammann where maximum curvature occurs in the anterior part of the glabella (Hammann 1974, pl. 12, fig. 192b). Thus *E. (?E.) mariana* is restricted in this paper to include, with the holotype, only the two specimens from the Valongo area; that figured by Curtis (1961, pl. 1, fig. 1 and refigured here, Pl. 78, figs. 5, 6) and a previously unfigured specimen (Pl. 78, fig. 7).

The relative lengths (sag.) of the frontal glabellar lobe and frontal area appear to show significant differences in the species *almadensis*, *clavigera*, and *mariana*. In an attempt to quantify these differences the three parameters B, F, and b_5 (text-fig. 3a) (symbols from Shaw, 1957 and Temple,



TEXT-FIG. 3. a, Outline of cranium of *Eccoptochile* (*Eccoptochile*) *almadensis* sp. nov. (after Hammann, 1974, text-fig. 39) showing parameters used in (b), (c) and text-fig. 4; b, c, Scatter diagrams of F against B and F against b_5 respectively with calculated regression lines for the species *almadensis*, *clavigera* and *mariana*.

1975) were selected since it is assumed the ratio of these measurements taken along a constant orientation will be virtually unaffected by deformation. When the three parameters are plotted on size frequency and scatter diagrams the species plot out in isolated and relatively restricted fields. Size/frequency histograms of the B:F and B:b₅ ratios (not illustrated) serve to distinguish *E. (?E.) mariana* from *E. (E.) almadenensis* and *E. (E.) clavigera* quite markedly. The regression lines of B against F and b₅ against F (text-fig. 3b and 3c) show that for *mariana* at least the lines appear to be clearly distinguishable and although few specimens were available to construct the graphs (*almadenensis*—14; *clavigera*—7; *mariana*—3) the contrast in gradient suggests the difference in growth rate is a useful criterion for separating this species. When the three parameters are plotted as ratios on a triangular graph (text-fig. 4) the three species plot out in discrete fields and the



TEXT-FIG. 4. Triangular plot for the species *almadenensis*, *clavigera*, and *mariana* using the three parameters B, F, b₅ (see text-fig. 3). For material and references used to construct the graph see text. Additional sources include Dr. J.-L. Henry (pers. comm.) and author's collection, University of Sheffield.

selected holotype for *E. (E.) almadenensis* occurs near the centre of scatter for that species. Since the number of specimens is small the fields have not been numerically defined. The species *clavigera* is clearly distinguishable by the presence of a long (sag.) frontal glabellar lobe (see text-fig. 2) and the flat profile of the glabella in lateral view. This difference in the relative length of the frontal lobe is shown in the groupings in text-fig. 4.

Using the methods outlined above, *E. (?E.) guillieri* cannot be distinguished from *E. (E.) almadenensis* since measurements taken from the photographs supplied by Dr. J.-L. Henry plot out near the middle of the *E. (E.) almadenensis* field (text-fig. 4). However, the strong glabella convexity

and subrounded outline of the glabella in dorsal view of *E. (?E.) guillieri* are characteristic enough to suggest it is a valid species. The specimen listed by Delgado (1908, p. 106), as '*Cheirurus* sp. n. (aff. *Ch. Sedgwicki* McCoy)', from 1400 m S 32° E of Covelo church (SG 1711) appears to show no important differences from *E. (E.) almadenensis*. The size of the free cheek, position, and structure of the eye in *Placoparina sedgwicki* (Whittard, 1958, pp. 112, 115) are distinctive, and although the Portuguese specimen listed by Delgado is imperfectly preserved (Pl. 79, fig. 5) it is assigned to *E. (E.) almadenensis*. Delgado (1908, p. 106) also recorded '*Cheirurus Guillieri* Trom. (aff. *Ch. clavigera* Beyr.)' from the Valongo area, 1650 m S 20° W from the hill of Santa Justa (SG 1704), but the forwardly expanding and relatively longer glabella (Pl. 79, fig. 1) is unlike that of the holotype of *E. (?E.) guillieri* and this specimen is also identified as *E. (E.) almadenensis*. Another specimen (Pl. 79, fig. 8) identified by Delgado (op. cit.) as '*Cheirurus Guillieri*' is here referred to *E. (?E.) cf. mariana* because, although it closely resembles the holotype, the deformed specimen precludes a definite identification. The eccoptochilid from Perhaver Beach, Cornwall, tentatively identified as *E. (E.) clavigera* by Whittard (1958, p. 115) and Sadler (1974, p. 73) is an incomplete cranidium (Pl. 78, fig. 8) which can now be confidently assigned to *E. (E.) almadenensis*.

Eccoptochile (Eccoptochile) cf. clavigera (Beyrich, 1845)

Plate 79, fig. 9

Figured material. One external impression of an incomplete flattened pygidium; specimen housed in Serviços Geológicos, Lisbon; drawer 3A2.

Horizon and locality. 1400 m S 32° E of Covelo church, Valongo; probably from upper part of Valongo Formation, probably Lower Llandeilo.

Description. Pygidium nearly twice as wide as long. Anterior margin gently rounded with nearly straight median portion and more strongly rounded posterior margin. Axis subtriangular in outline (articulating half ring not preserved) with outwardly curved axial furrows. Axis probably slightly wider than long, reaching back to about one-half length of pygidium; three axial rings and a small triangular terminal piece; rings decrease in length posteriorly, ring furrows shallow medially (except third axial ring furrow). Axial furrows shallow and weakly defined and not present posterior to the second axial ring furrow. Three pairs of broad, bluntly rounded, spinose pleural ribs. First and second ribs start opposite first two axial rings and curve gently outwards and backwards; third pair directed posteriorly. 7-8 shallow pits on first pleural ribs situated at about midlength (exsag.) of rib and extend for about one-quarter along the rib. Only 1-2 pits are present on the second rib and none on the third. Surface of pygidium covered with fine, closely spaced tubercles except in the shallow rib pits.

Discussion. The poor preservation of this specimen makes it difficult to compare length to width ratios with the type material of *E. (E.) clavigera* (Beyrich, 1845, plate (unnumbered), fig. 3), which appears to be relatively wider. In all other respects it closely resembles the holotype. The present material is very similar to the specimen referred to *E. (E.) clavigera* by Přibyl and Vaněk (1969, p. 3, fig. 8) except that in the latter the rows of pits on the pleural ribs extend further along the rib, although this is not so apparent in other specimens figured by those authors (op. cit. pl. 3, figs. 6, 7).

RANGE AND DISTRIBUTION OF *E. (E.) ALMADENENSIS*, *E. (E.) CLAVIGERA*,
AND *E. (?E.) MARIANA*

E. (E.) almadenensis is the most widespread species in Iberia and the Armorican Massif and probably also occurs in southern Cornwall. It first appears in the basal Llandeilo of Navatrasierra in central Spain (Hamman 1974, p. 15) and occurs in the Lower Llandeilo of north Portugal, the Armorican Massif, and probably southern England. There is evidence that the species possibly also persists into the Caradoc in the region south of Rennes, Brittany (Lindström *et al.*, 1974, p. 20). There

is no record of it continuing into the Ashgill. *E. (?E.) mariana* (as understood in this paper) is a relatively restricted species, recorded only from the Ciudad Real region in south central Spain where it is of Upper Llandeilo age and from the area around Covelo, near Valongo in north Portugal (Lower Llandeilo). *E. (E.) clavigera* is poorly represented in Spain and north Portugal; *E. (E.)* cf. *clavigera* (a deformed pygidium) occurs in probably Lower Llandeilo beds in the Valongo area and *E. (E.)* aff. *clavigera* (a hypostoma and pygidium) is recorded from Caradoc beds north of Almaden, central Spain (Hammann 1974, p. 111). A deformed eccoptochilinid cranidium from the ?Caradoc of central Portugal, 50 km SSE of Coimbra (A. H. Cooper collection), is probably referable to *E. (E.) clavigera* and the Delgado collection housed in the Serviços Geológicos, Lisbon, contains large specimens of *E. (E.) clavigera* from the Mação region 80 km SSE of Coimbra. The age of the Mação specimens is not known but the associated fauna contain *Actinopeltis* and *Eoharpes* and could indicate an Upper Llandeilo to Caradoc age. *E. (E.) clavigera* is common in Bohemia where it ranges from the Libeň Formation to the Bohdalec Formation (Havlíček and Vaněk 1966) and is associated with *Actinopeltis*. Havlíček and Marek (1973) have revised the chronostratigraphic terminology for the Bohemian sequence and they recognize a Beroun Series of middle Llandeilo to upper Caradoc age which includes the range of *E. (E.) clavigera*. In Bohemia *Eoharpes* dies out in the Dobrotivá Formation which is considered by these authors to be equivalent in age to the lower part of the Llandeilo.

Any conclusions regarding faunal migrations and phylogeny within the group must await further work in particular on the existing collections in Lisbon.

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